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major
components of food

Vitamins Minerals

Required in small quantities.

Carbohydr. Fats Proteins

- Biomacromolecules in food \rightarrow cannot be utilised by our body in their original form.

They have been broken down & converted into simpler subst. in digestive system.

Digestion

← This process

Carried out by
digestive enzymes
by

Mechanical methods

↓
Biochemical
methods

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AIR 1747

NCERT THREAD NOTES

Digestive system \rightarrow Alimentary canal + Associated glands

Alimentary Canal

- * Begins with → anterior opening [MOUTH] → ends posteriorly with [ANUS]

Leads

to Buccal / oral
Cavity / cavity

has

~~No. of teeth~~

→ Muscular tongue

Each tooth → embedded in a
socket of jaw bone
(THECODOONT)

- Majority of mammals (including human being)

Forms
two sets
of teeth
during life

Temporary/Milk/Deciduous
Teeth

Permanent/Adult
Teeth

This type of dentition
↓
Diphyodont

- Adult human has
32 permanent teeth
4 types ↓ heterodont

(I) (C) (PM) (M)
↓ ↓ ↓ ↓
Incisors Canine Premolars Molar.

- Order of arrangement of teeth

In each half of upper
& lower jaw.

(I)	(C)	(PM)	(M)
2	1	2	3

- Enamel → hard chewing surface of teeth $\xrightarrow{\text{helps in}}$ Mastication of food.

- Tongue → Freely movable muscular organ

Attached to floor of oral cavity by 2 Frenulum.

Upper surface of tongue has small projection "Papillae".

Some of which bear taste buds.

Oral Cavity $\xrightarrow{\text{leads into}}$ Short pharynx (serves as common passage for food and air)

opens into

Oesophagus

opens into

Trachea

* A cartilag. flap - epiglottis prevents the entry of food into glottis (opening of windpipe)

'J' shaped bag - Stomach

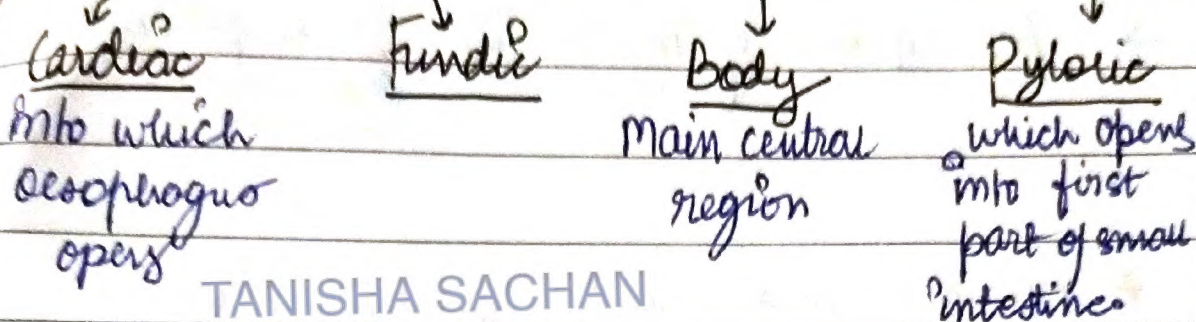
leads to

- Thin, long tube
- Extends posteriorly through the neck, thorax & diaphragm

A muscular sphincter "gastro-oesophageal" regulates the opening of oesophagus into stomach.

→ Located in upper left portion of abdominal cavity.

Stomach has four parts

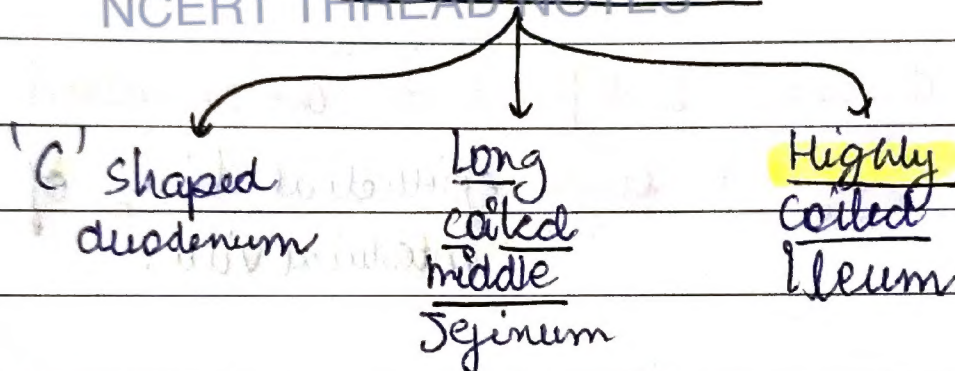


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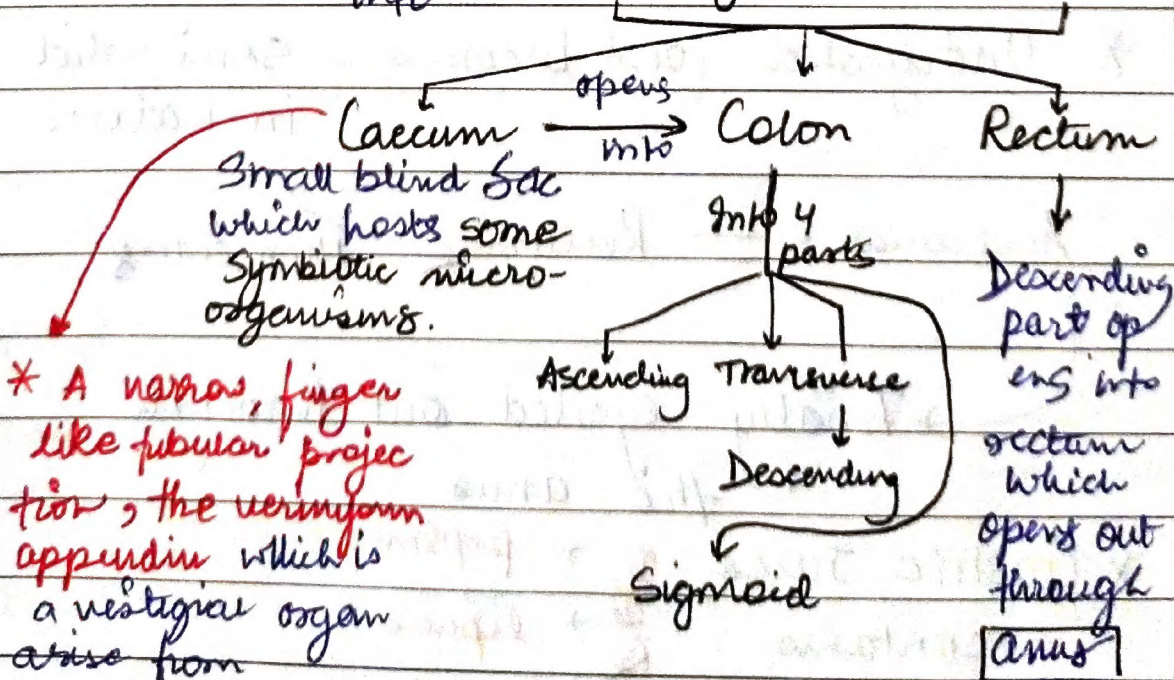
Small Intestine

NCERT THREAD NOTES



Opening of stomach $\xrightarrow{\text{pyloric sphincter}}$ Duodenum

Ileum $\xrightarrow{\text{opens into}}$ Large Intestine



* A narrow, finger like tubular projection, the vermiform appendix which is a vestigial organ arise from caecum.

* In stomach, mainly protein digestion takes place.

* Absorption of medicine - takes place in stomach

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* Tongue manipulates food for proper mastication by mixing with saliva.

* The digested end products are absorbed into body through epithelial lining of intestinal villi.

* Most of water - absorbed in large intestine

* Undigested food becomes - semi solid in nature

Anal canal ← Rectum ← then enters

→ Finally egested out through the anus

* Gastric Juice contains

- ① → pepsin
- ② → lipase
- ③ → Rennin



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Wall of Alimentary Canal → From "Oesophagus" to "Rectum"

Possess 4 layers

Serosa

Outermost layer
of thin mesothelium
(epithelium of the
visceral organ)
with some connective
tissue fibres.

Muscularis

of Smooth Muscles
arranged into

Inner circular
Outer longitudinal

* An oblique muscle
layer may be present
in some region.

Sub Mucosal layer

Formed of loose
connective tissue
containing

→ nerve
→ blood
→ lymph vessels

Intodenum,
glands are also
present in sub
mucosa.

Mucosa

Innermost
layer lining
of the lumen
of alimentary
canal

Irregular
folds in
stomach
↓
Rugae

Small
finger like
foldings
↓
Villi
(in small
intestine)

* Cells lining produce → Numerous projections (microvilli) → giving → Brush border appearance

These → modifying
Surface area ↑ enormously

NCERT THREAD NOTES

* Villi → supplied with a → network of capillaries
→ large lymph vessel → lacteal

* Mucosal Epithelium has → Goblet cells → secrete → mucus
helps in lubrication

* Mucosa forms gland in → stomach (gastric glands)
→ crypts in b/w bases of villi
in intestine (Crypts of Lieberkuhn)

* All the four layers show modifications in different parts on alimentary canal.

Digestive Glands

Associated with Alimentary canal

- Salivary gland
- Liver (with gall bladder)
- Pancreas.

Saliva produced by
(3 pairs of salivary glands)
= 6 salivary glands

near

Parotids
(cheek)
Stensen's duct

Submandibular
/ Sub-mandibular
(Lower jaw)
Wharton

Sub-linguals
(below the tongue)
Bartholin

* These glands situated just outside the buccal cavity secrete salivary juice into the buccal cavity.

Liver

→ largest gland of body

→ weighs 1.2 - 1.5 kg (in adult human)

→ Situated in abdominal cavity → Just below diaphragm & has 2 lobes

Structural & functional unit
containing hepatic cells in
the form of cords

Hepatic Lobules.

Covered by: Thin connective
tissue sheath called
Glisson's Capsule.

Bile

secreted through
hepatic cells
passes through
hepatic ducts

stored in

Thin muscular bag
"Gall bladder"

CYSTIC DUCT

COMMON
BILE DUCT

PANCREAS

Compound gland
elongated organ
situated b/w the limbs
of 'C' shaped duodenum

hepato-pancreatic
duct

PANCREATIC
DUCT

'C' shaped.

sphincter of oddi

Exocrine

alkaline
pancreatic
juice

Endocrine

Hormones

- insulin
- Glucagon

DIGESTION OF FOOD

↓
Accomplished by 2 Mechanical & chemical process. with the help of teeth & tongue and mix with saliva

Buccal cavity $\xrightarrow{\text{Two major functions}}$ Mastication of food
Facilitation of swallowing.

'Mucus' in saliva helps in ① Lubricating
② adhering \rightarrow the masticated food particles into Bolus

Bolus further passes down through the oesophagus by successive waves of muscular contraction - Peristalsis.

oesophagus \leftarrow then into pharynx
(by swallowing or deglutition)

Gastro-oesophageal sphincter. controls the passage of food into the stomach.

Chemical process of digestion is initiated in the oral cavity.

- Saliva has
- Electrolytes (Na^+ , K^+ , Cl^- , HCO_3^-)
 - Enzymes - salivary amylase
 - Lysozyme

Hydrolytic action of carbohydrate splitting enzyme

Starch $\xrightarrow[\text{pH 6-8}]{\text{Salivary amylase}}$ Maltose, dextrin

30% of starch hydrolysed.

Lysozyme - Antibacterial agent (prevent infections)

Mucosa of stom. has gastric glands

Mucus neck cells (secrete mucus)

Peptic/chief cells (secrete proenzyme - pepsinogen)

Parietal/Intrinsic cells (secrete HCl & Intrinsic factor essential for the absorption of vit. B₁₂)

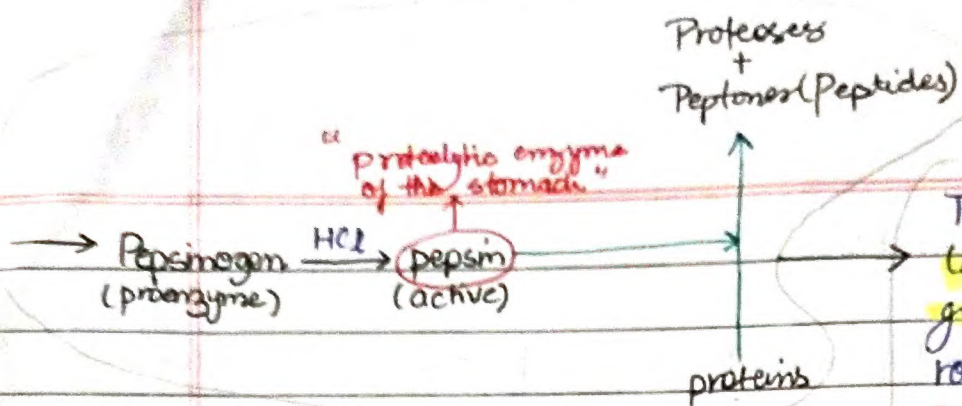
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Food mixes thoroughly with the acidic gastric juice of stomach by churning movements of muscular wall. called \rightarrow Chyme.

Stomach stores food for 4-5 hrs



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The mucus & HCO_3^- (bicarbonate) present in gastric juice play a imp role in lubrication & Protection of mucosal epithelium from excoriation by the highly conc. HCl.

Rennin is a proteolytic enzyme found in gastric juice of infants. It helps in digestion of milk protein.

HCl provide - acidic pH optimal for pepting. -1.8

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Small amount of Lipases are also secreted by Gastric glands.

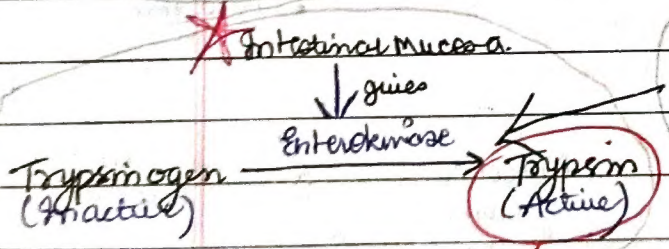
Various types of movements are generated by the muscularis layer of the small intestine. This helps in thorough mixing up of the food with various secretions in intestine & thereby facilitate digestion.

released through hepato pancreatic duct.

- ① Bile
 - ② Pancreatic juice
 - ③ Intestinal juice
- 3 secretions released into small intestine.

Pancreatic Juice

- ① Inactive enzyme → Trypsinogen, Chymotrypsinogen, procarboxypeptidase
- ② Amylase
- ③ Lipases
- ④ Nuclease.



Other enzymes in pancreatic juice

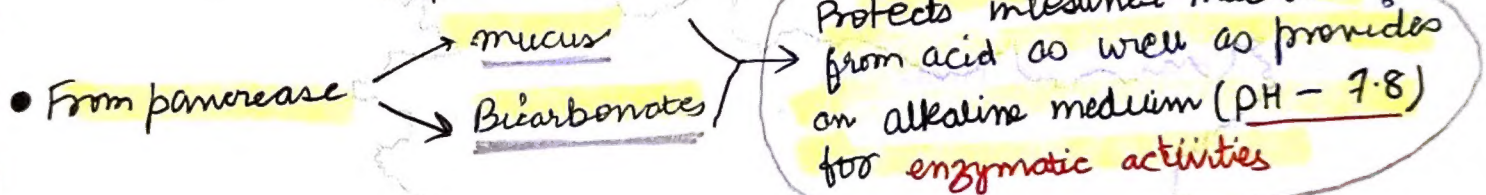
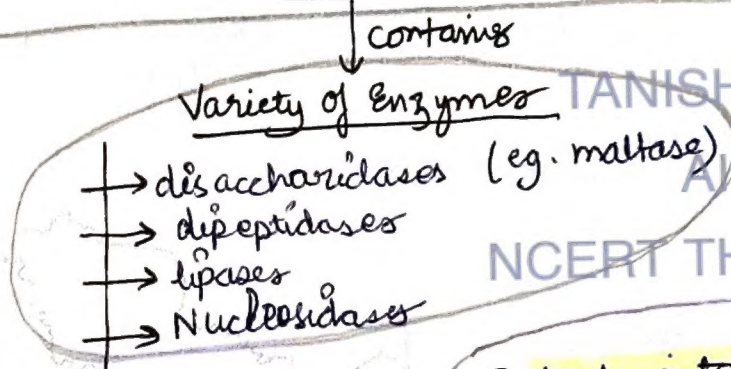
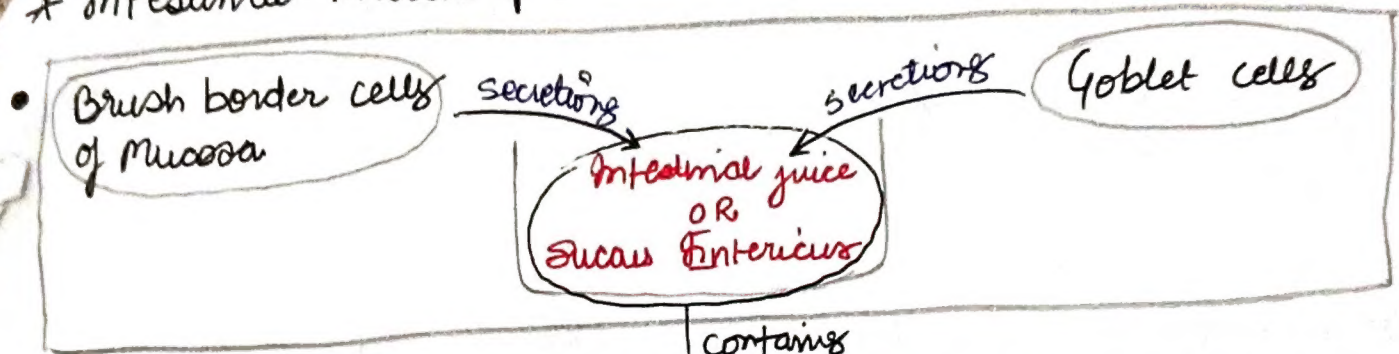
- Bile ~~secretions~~ released into duodenum contains
- Bile pigments (Bilirubin/Biliverdin)
 - Bile salts
 - Cholesterol
 - Phospholipids
 - NO enzymes

Breakdown of fats into small micelles

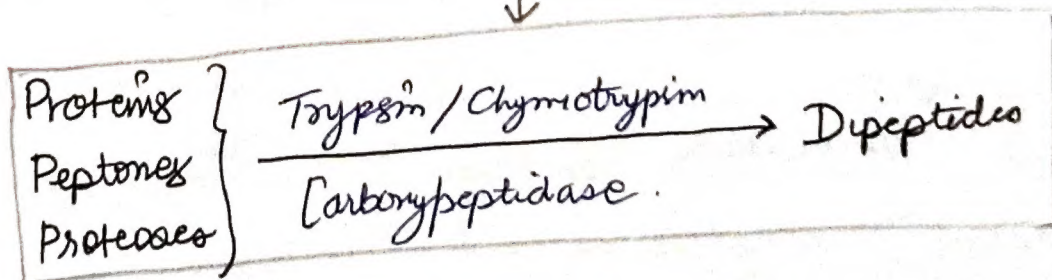
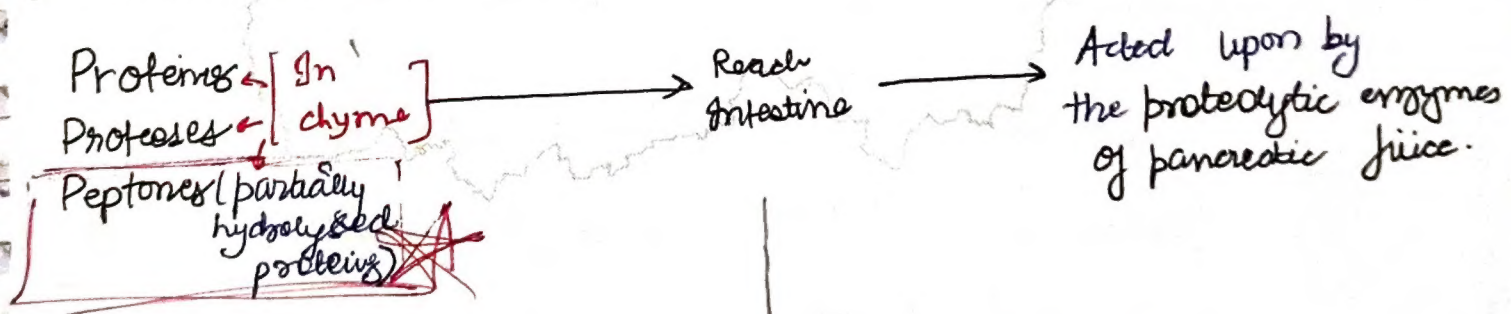
Bile helps in emulsification of fats and also activates lipases



* Intestinal mucosal epithelium has \longrightarrow Goblet cells $\xrightarrow{\text{secrete}}$ Mucus



• Sub mucosal glands - Brunner's Gland.





- Carbohydrates in chyme \rightarrow hydrolysed \rightarrow By pancreatic amylase

Polysaccharides (starch) $\xrightarrow{\text{Amylase}}$ Disaccharides

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- Fats \rightarrow broken down \rightarrow By lipase \rightarrow with the help of bile

Fats $\xrightarrow{\text{Lipase}}$ Diglycerides \longrightarrow monoglycerides

- Nucleases \rightarrow in pancreatic juice \rightarrow on nucleic acid

Nucleic acid $\xrightarrow{\text{Nucleases}}$ Nucleotides \longrightarrow Nucleosides

- The enzymes in small intestine \rightarrow act on end product of above reaction \rightarrow to form the respective simple absorbable form. These steps occur very close to the mucosal epithelium of intestine.

Dipeptides $\xrightarrow{\text{dipeptidases}}$ AA

Maltose $\xrightarrow{\text{Maltase}}$ 2 Glucose

Lactose $\xrightarrow{\text{Lactase}}$ Glucose + Galactose

Sucrose $\xrightarrow{\text{Sucrase}}$ Glucose + Fructose

Nucleotides $\xrightarrow{\text{Nucleotidase}}$ Nucleosides $\xrightarrow{\text{Nucleosidase}}$ Sugars + Bases

Di & monoglycerides $\xrightarrow{\text{lipase}}$ Fatty acids + Glycerol

Breakdown of Biomacromolecules

occurs

In the duodenum region of small intestine.

simple substance absorbed

Jejunum & Ileum

Passed to the large intestine

"Undigested" & "Unabsorbed" subst.

No significant digestive activity occurs here

Functions :

(i) absorption of some ~~water~~ ~~minerals~~ ~~certain drugs~~

(ii) Secretion of mucus helps in ^① adhering the waste (undigested) particles together & ^② lubricating it for an easy passage.

"Undigested" & "unabsorbed" substance called faeces.

enters

Caecum

(through the Ileo-caecal valve)

↳ prevents the back flow of faecal matter

It is temporarily stored in Rectum till defaecation.

Activities of Gastro-Intestinal tract

under "neural" & "hormonal" control.

↓ for
proper co-ordination of different parts

① Sight, ② Smell & for the ③ presence of food in oral cavity

↓ stimulates
Secretion of saliva

↓
Gastric & Intestinal secretions are also
stimulated by the neural signals.

↓
Muscular activities of different parts
of alimentary canal

→ Mediated by
neural mechanism

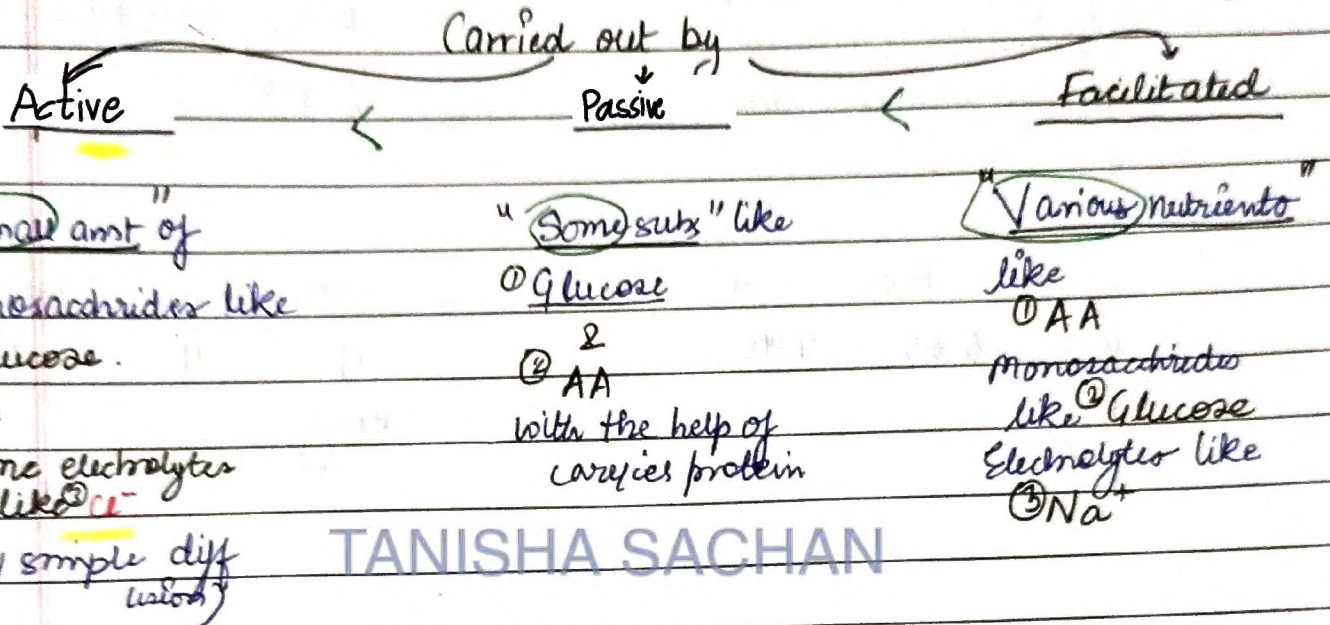
↓ both
local CNS

Hormonal Control - Secretion of digestive juices
carried out by local hormones

↑ produced by
Gastric & Intestinal
Mucosa.

Absorption of digested products :

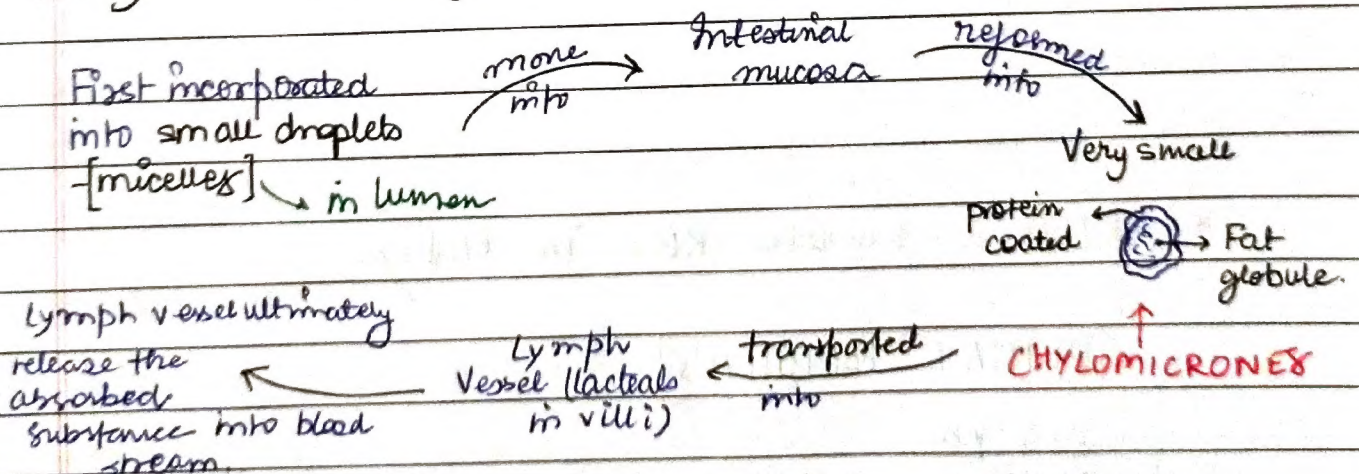
End products of digestion \longrightarrow Pass through Intestinal mucosa $\xrightarrow{\text{into}}$ Blood or Lymph.



* The passage of these substance $\xrightarrow{\text{into}}$ blood, depends on conc gradient.

* Transport of water - depends on osmotic gradient.

Fatty acids & Glycerol - Insoluble \rightarrow X be absorbed into blood.



(*) Maximum absorption occurs in \rightarrow small intestine

* The energy requirements of animals, the energy content of food, are expressed in terms of measure of heat energy bcz heat is the ultimate form of all energies.

Cal (calorie) Joule (Joule)

Gross calorific Value

↓
Amt of heat liberated from complete combustion of 1g food in a bomb calorimeter. (a closed metal chamber filled with O_2)

Physiological Values

The actual amt of energy combustion of 1g food.

Carb	Prot.	Fat
4.1	5.65	9.45
Kcal/g		

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Carb	Prot.	Fat.
4	4	9
Kcal/g		

NCERT THREAD NOTES

Absorbed substance → Reach the tissues which utilise them for their activities
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born 2 inspire

process
↓
Assimilation

Digestive waste → solidified into (in rectum) coherent faeces.

carried out by → Man peristaltic movements.

Voluntary process

(defecation)

egestion of faeces to outside through anal open opening

initiates
Neural reflex

causing an urge or desire for its removal.

* Liver - secretes RBC in embryo.

DENTAL FORMULA'S

(25 ym)
1) ADULT - $\frac{2123}{2123}$

2) INFANT - $\frac{2102}{2102}$
↓
Pse molar & last molar absent

2) ADOLESCENT - $\frac{2122}{2122}$
(18 yrs)
↓
Wisdom tooth absent.



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PEM → Protein Energy malnutrition.

- Dietary deficiency of $\begin{cases} \text{Proteins} \\ \text{Total food calories} \end{cases}$
- Widespread in many "underdeveloped countries of" $\begin{cases} \text{South Asia} \\ \text{South East Asia} \\ \text{South America} \\ \text{West Africa} \\ \text{Central Africa} \end{cases}$
- Affects large section of popul. during $\begin{cases} \text{Drought} \\ \text{Famine} \\ \text{Political Turmoil} \end{cases}$

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- Happened in $\begin{cases} \text{Bangladesh: during liberation of war.} \\ \text{Ethiopia: Severe drought in mid-80s.} \end{cases}$

Marasmus:

→ Simultaneous deficiency of proteins & calories.

→ Found in the infants of < 1 yr age.

→ Mother's milk replaced too early by other foods which are poor in $\begin{cases} \text{Proteins} \\ \text{Caloric value} \end{cases}$

→ Often happens when mother has 2nd pregnancy or child births when the older infant is still too young.

• Impairs Growth & Replacement of tissue proteins

• Extreme emaciation of body

• Thinning of limbs

• Skin becomes $\begin{cases} \text{dry} \\ \text{thin} \\ \text{wrinkled} \end{cases}$

• Growth Rate ↓

• Body weight ↓

• Growth & development of Brain & mental faculties impaired.

Kwashiorkor:

→ Prod. by Protein deficiency "unaccompanied" by calories deficiency

→ Results from replacement of mother's milk by a high calorie - low protein diet in a child of > 1 yr age.

→ Wasting of muscles

→ Thinning of limbs

→ Failure of growth & Brain develop.

→ Some fat is still left under skin (unlike marasmus)

→ Extensive oedema.

→ Swelling of body parts.



Disorders of digestive system.

Most common: Inflamm. of intestinal tract.

↓ due to

Bact. / Viral Infection.

OR.

Parasitic Infection. (In intestine)

- ① Hookworm, Pinworm.
- ② Tape worm, thread worm.
- ③ Round worm.

Saundice

Liver affected.
Skin & Eyes turn yellow.

↓ due to
deposit of bile pigm.

Vomiting

Ejection of stomach content through mouth.

This Reflex action controlled by vomit centre (in medulla)

A feeling of nausea precedes ↓

vomit

Diarrhoea

• Abnormal freq. of bowel movement &

Increased liquidity of faecal discharge

✗ It reduces the absorption of food.

Constipation

Faeces retained within colon.

Bowel movements occur irregularly.

Indigestion

Food is not properly digested leading to a feeling of fullness (causes)

→ maldig. enzyme secr.

→ anxiety

→ food poisoning

→ overeating

→ Spicy food.

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